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MICROANALYSIS OF NY/NJ HARBOR SEDIMENTS USING SYNCHROTRON X-RAY BEAMS*

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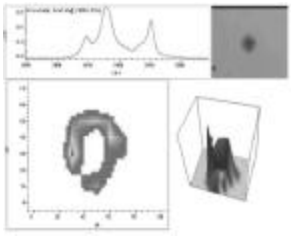
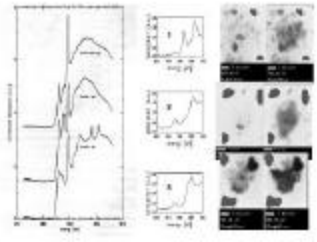
Sediments found in the New York/New Jersey Harbor are widely contaminated with organic and inorganic compounds of anthropogenic origin. As a result, the environmental health of the Harbor has deteriorated and the efficient operation of the Port compromised by difficulties in disposing of sediments resulting from maintenance and improvements of navigational channels. Knowledge of the properties of the sediments on a micro-scale is useful in understanding the transport of contaminants through the environment, for developing effective methods for sediment decontamination, and for subsequent beneficial use of the cleaned sediments. We have investigated several properties of these sediments using synchrotron radiation techniques. These include computed microtomography using absorption and fluorescence contrast mechanisms, x-ray microscopy, microbeam x-ray fluorescence, and Fourier transform infrared spectroscopy for measurements of microstructure, distribution of metals on individual sediment particles, and chemical forms of the contaminants on a micrometer scale. Results from these experiments will be presented.

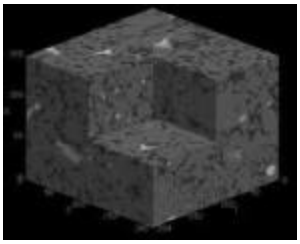
Typical results are shown here. They illustrate some of the features of the synchrotron analytical techniques. The spatial resolution for the three examples is 0.015, 0.005 and 0.0002 mm so that heterogeneity can be investigated on individual grains. FTIR spectroscopy (Figure 1) is used to investigate the chemical state of contaminants from the Harbor. The spectrum shows evidence for C-H stretch bonds at about 2900 cm^{-1} that are attributed to the presence of petroleum products. Soft X-ray microscopy (Figure 2) provides structural information on colloidal-size particles as well as chemical fingerprints for carbonaceous materials based on absorption (XANES) spectroscopy. The column at the left shows spectra for natural organic materials. The top two rows of the other columns show absorption spectra and particle structures of sediment particles after cleaning with a proprietary washing process. The bottom row shows results for the untreated sediments. X-ray computed microtomography (Figure 3) gives three-dimensional data that defines the microgeometry of the sediments. The results can be used to model the sedimentation process and for realistic computations of contaminant transport through this porous medium.



FTIR spectroscopy



Soft X-ray spectromicroscopy



Computed tomography

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